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"MOSQUITO" OR "BUG."?

In Chambers' "Twentieth Century Dictionary of the English "Language" the following is given as one of the meanings of the word "name"—"appearance, not reality." Few would, at first thought, define the meaning of the word "name" thus, but instances in which this definition most certainly applies will occur to the mind at once. The instance which first came to the mind of the writer was, as might perhaps be expected, that afforded by the case of the so-called "Tea Mosquito." Appearance, not reality. Its appearance, thought the planters of fifty years ago, is that of a mosquito, and they called it the tea mosquito. In reality it is a bug, while a mosquito is a fly--and there is a wide gulf fixed between a bug and a fly.

Old traditions, however, die hard, and, bug or no bug, the arch-enemy of tea has earned his unenviable reputation as the "Tea Mosquito." So long ago as 1872 one Peal, a tea planter with some knowledge of entomology, wrote of the pest under the name of the "Tea Bug," but subsequent writers failed to follow his good example, and adopted the generally accepted, but entirely misleading, name of "Tea Mosquito." The result of this has been that the name of "Tea Mosquito" has become so thoroughly associated with the tea-bug that when the writer makes a belated attempt to correct the misnomer by writing of "Factors Affecting "the Control of the Tea Mosquito Bug" the publication is referred to, almost invariably, as "Factors Affecting the Control of the Tea Mosquito."

It cannot but be expected that such a misnomer, involving, as it does, reference to an insect of entirely distinct character, mode of existence, and habits, should lead to misunderstanding as to the nature of the insect, and to misconception of the type of control measures likely to be effective. This has happened to a great extent in the past, and not many years ago the writer visited an estate, the manager of which poured gallon after gallon

of kerosene oil on the water in the drains, under the impression that by doing so he killed the young insects by the thousand. The "tea mosquito" was always to be found on his garden, he declared—they were indeed to be found at the time—but they never made headway because his treatment killed them all in the young stages. The writer stayed with him for two days, and argued the point most of the time, but without avail. The reply was that while it might be wrong in theory, it worked out exceedingly well in practice, and so long as his garden did not suffer from the pest he intended to continue. Such a misconception could not possibly have arisen in his mind if the insect had been called the "tea bug," and he would never have wasted the considerable amount of money which, literally as well as metaphorically, was thrown down the drains each year.

This misconception is largely disappearing. The tea planter of the present day takes more interest in his insect foes than did his predecessor of years ago, yet some find it difficult to believe that the insect could ever have been called a mosquito, and still have little in common with a mosquito, while every new man who comes out to tea, on hearing the name for the first time, associates with the insect all he has heard of the domestic mosquito, and is predisposed to attribute to the bug the characteristics of that insect.

Half-hearted attempts have been made, in the past, to remove this misconception, but no attempt has yet been made, so far as the writer is aware, to place on record, in a publication accessible to all tea planters, an adequate account of the vast difference which really exists between the domestic mosquito and the tea "mosquito," and to show the futility of looking to control methods designed to deal with the domestic mosquito for assistance in the fight against *Helopeltis*.

It is proposed to make an attempt to do so now.

The insects constitute a numerous and motley assemblage. There are more than 300,000 different species, and they show endless variety in form and habit. Diverse though they be, however, they exhibit certain relationships one to another, and on the

basis of these relationships individual species are brought together into groups which are called "genera"; related genera are grouped into larger divisions, which are called "families", and related families are brought together into still larger groups, which are known as "orders". In the most simple form of classification nine different orders of insects are recognised, which are as follows :—

(1) The order *Aptera**—These insects are all wingless, and have mouths adapted for chewing or sometimes imperfectly adapted for sucking. They change very little in appearance and habit in passing from the youngest to the adult stage. The common fish insect is a typical example of this order which must have come to the notice of most people who live in India.

(2) The order *Orthoptera*—This order includes the cock-roaches, earwigs, leaf and stick insects, the praying mantis, grasshoppers, crickets, and locusts. There are four wings. The front pair are horny, and lie flat against the back, acting as covers for the second pair, which are membranous, and in repose are folded beneath the former after the manner of a fan. The mouth parts are adapted for chewing, and the appearance and habits of the insect show little alteration in passing from the youngest to the adult stage.

(3) The order *Neuroptera*—This order includes the dragon-flies, ant-lions, may-flies, and such like and also the termites or white-ants (another misnomer).

*These scientific terms are not so terrible as they appear. It will be noticed that each one ends in—ptera. This ending is derived from the Greek word pteron, which means a wing. The first part of each word also has a definite meaning, and refers to the character of the wings, thus—*A-ptera*, without wings; *Ortho-ptera*, straight wings; *Neuro-ptera*, nerve wings; *Hymeno-ptera*, membranous wings; *Coleo-ptera*, sheath wings; *Lepido-ptera*, scale wings; *Di-ptera*, two wings; *Thysano-ptera*, fringed wings; *Hemi-ptera*, half wings. From the short description of each order given above it will be seen that each name really forms a concise description of one of the chief characteristics of that particular order. That is why they are found to be so convenient. They are not used, as was once alleged by a tea-planter friend to the writer, to mystify and impress the layman.

The insects in this order have two pairs of membranous wings which are generally covered with a mesh, or net-work, produced by the intersection of numerous wing-veins, or nerves. The mouth parts are adapted for chewing, and in the majority of cases there are distinct larval, pupal, and adult stages, totally dissimilar, both in appearance and habit, from one another.

(4) The order *Hymenoptera*—In this order the insects are furnished with two pairs of transparent membranous wings, of which the front pair is always larger than the hind. In this order the wings do not close up in repose. The mouth parts are adapted for biting and chewing, though in some cases, as in the bee, there is also a proboscis. The various stages which the insect passes through in growth are very dissimilar in form and habit, the first stage being that of a helpless grub, the second that of an equally helpless chrysalis, and the adult stage, an active flying insect. This order includes the ants, bees, and wasps.

(5) The order *Coleoptera*—These are the beetles, characterised by the front pair of wings being hardened into horny sheaths which fit closely on the back in repose, with a perfectly straight edge where they come into contact down the middle of the back, and which cover the hind wings, which are transparent and membranous and fold beneath the sheaths in repose, often in a highly complicated manner. The mouth parts are adapted for biting and chewing. The first stage in the life of beetles is that of a grub, then follows a chrysalis stage, and finally the adult beetle emerges.

(6) The order *Lepidoptera*—The butterflies and moths. These are readily recognised by all. The large, often beautifully coloured wings, owe their colour

and design to an arrangement of scales attached to what are really membranous wings. The mouth parts in the adult are adapted for sucking, and during their life cycle the insects pass throught he very dissimilar caterpillar and chrysalis stages familiar to all.

(7) The order *Diptera*—This order contains the flies—also the gnats and mosquitos, which are true flies. There is only one pair of wings, which are membranous, the hind pair being represented by curious "balancing organs." The mouth parts are adapted, in some cases, for sucking, as in the house fly, in others for piercing and sucking, as in the gnats and mosquitos. The various stages during growth are very dissimilar. The first stage is a grub, represented, in the case of the housefly and others, by the familiar maggot, and in the case of gnats and mosquitos by an active worm-like grub. The second stage is a pupa, or chrysalis, and the third stage is the adult stage, or winged form.

(8) The order *Thysanoptera*—These are the Thrips, which have four very narrow fringed wings, and in which the mouth-parts are adapted for scraping and sucking. There is little difference, in either appearance or habit, in the various stages of the insect throughout life, the newly hatched young being a typical Thrips, though of course wingless, and capable of obtaining nutriment in the same manner as the adult.

(9) The order *Hemiptera*—This order comprises the true bugs, and includes, amongst others, the cicadas, scale-insects, and such insects as the tea mosquito bug, the tea green fly, and the tea seed bug. In this order there are two pairs of wings, of which the first pair are in many cases of a horny consistency in the half nearest to the point of attachment

to the body, while the free half is membranous. From this character is derived the name *Hemiptera*. The hind pair of wings is membranous, and in repose lies flat on the back beneath the front pair. The mouth-parts, in the insects of this order, are adapted for piercing and sucking, while the insect begins life in a form very much like the adult, and having the same habits, and exhibits little change of form throughout its growth.

Observant readers will have noticed that in the above short account of the orders we have "placed" the mosquito and the "mosquito" bug. The 300,000 and odd species of insects fall into nine great groups, each of which includes a large and diversified collection of different forms, and the mosquito and the "mosquito" bug are so very different, one from the other, that they do not even fall into the same primary group, or order. They are both insects, but directly an attempt is made to carry comparison further, one is compelled to say—the one is this, the other is that, so wide is the difference between them. There is one other point of similarity, which is that both are provided with mouth-parts adapted for piercing and sucking, but even there a dissimilarity is quickly apparent, for the mouth of the one is very different in appearance and construction from that of the other. It is not proposed, however, to go into details of the structural dissimilarities of the insects. This would involve much that is technical, and could serve no useful purpose to the tea planter. It will, however, be of use to the tea-planter to be acquainted with the differences in the life-history and economy of the two insects, for he will then realise the mistakes which he is likely to make if he allow himself to acquire the impression that the "mosquito" bug is a mosquito.

Both the mosquito and the mosquito bug begin life, in common with most insects, by emergence from an egg, but here the similarity ceases. The eggs, to begin with, are laid in very dissimilar situations, and the young insects, on emergence, are not only very unlike one another in appearance, but are compelled

to exist in very different environmental circumstances. The eggs of the mosquito are laid on the surface of water; those of the mosquito bug are thrust into the shoots of a plant. The young mosquito, therefore, emerges into a pool of water, while the young mosquito bug finds itself on the stem of a plant. They are, moreover, different in appearance, as is only to be expected when one is adapted to live in water, and the other to live on a bush. The young mosquito is an active, wriggling, worm-like grub, with a mouth adapted for browsing on the rubbish which accumulates in stagnant pools and collections of water in hollow places, and bears no resemblance whatsoever to the parent insect, either in appearance, habits, or its manner of obtaining food. The young mosquito bug, however, is a typical insect, bearing a considerable resemblance to the adult, and having a piercing and sucking mouth with which it is able to draw nourishment from the plant quite as well as the parent insect. Its habits, mode of life, and location are identical with those of the parent, from which it differs only in not being capable of flight or of reproducing its kind.

Both forms, like all insects, grow by a series of stages, which are marked by the shedding of the old skin, or moulting. The young mosquito still retains its grub-like form until the stage immediately before the adult stage, when it becomes a pupa. This is a transition stage, in which the insect takes no food. In the case of the young mosquito bug, however, there is no pupal form, the insect merely becomes more and more like the parent at each moult, with the wings and spine developing a little further at each stage, and continues to feed actively the whole time after a manner entirely similar to that of the adult, never leaving the bush, except by accident, or to run to another. The last moult of all, in the case of the mosquito, results in the emergence of the adult insect from the pupa, when it leaves the water and lives entirely in the air. In the case of the mosquito bug, however, the adult form results from the moulting of an insect very similar to itself, save that the wings are not fully developed.

There are many structural differences between the two insects, but they can be easily differentiated by the fact that the true mosquito has only two wings, and no vertical spine on the back,

while the mosquito bug has four wings, and has on its back, between the point of attachment of the wings, a vertical spine with a knob on the end, much as if a small black entomological pin had been stuck into it from above, but not so far as to project below.

So far as planters are concerned, the main difference to be noted is the fact that the tea "mosquito" bug is in no way related to the the true "mosquito," save that both are insects, and that their habits, life-cycle, and food requirements are so exceedingly different that, before any attempt at applying remedial measures be undertaken, care should be taken to make sure that such measures are not meant to be applicable to the true mosquito, as there is little or no likelihood of such measures being of any value in the control of the tea mosquito bug.

There are many who may think this article superfluous, and to such, if they have read it, the writer makes due apology, but there are others, now in tea, who are still somewhat misled by the name, and there are others, not yet in tea, who may be misled by the name, and it is for such that the article is intended.

E. A. A.

SKETCH MAP OF THE BISHNATH DISTRICT

Scale - 8 Miles to 1 inch

BENGAL ART STUDIO, CALCUTTA.

SOIL SURVEY NOTES

BY

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THE DARRANG DISTRICT

PART V.—Bishnath

The Bishnath District, including Boroi and Behali, contains practically the same types of soil as does Tezpur.

The greater part of it is apparently the old bed of the Brahmaputra, which appears to have run very close to the hills at the Boroi end, turned towards the south-west near Singlijan, and completely surrounded the red bank, leaving a roughly horse-shoe-shaped island.

This rough horse-shoe remains above the level of the sandy flat land as a bank, shaped like a horse-shoe, of red soil on which stand the gardens Borpukhuri, Shakomato, Majulighur, Pertabghur and Sadarughope. The red bank outcrops again to the west at Korsontollah, and forms the subsoil of much of the land in the neighbourhood.

The only other red bank soil in the district is at Singlijan in the low foothills on the northern border.

After turning south-west at Singlijan the soils north of this old Brahmaputra bed are probably of the types found in Mangaldai, or possibly of the coarsely sandy but very rich soils found in the western Dooars, in both cases representing wash from old rich surface soils in the hills.

The existing gardens seem to be too far south to show the richness of the Mangaldai upper bed, but patches of the Mangaldai silt-loam types occur on many gardens.

Some of the more northerly gardens, *e.g.*, Dikorai, Rungaghur, Borjuli, on forest land, have probably received some enrichment

by wash from the hills, but the majority of the soils appear to be river deposits of more recent origin.

The accompanying diagram shows a section of the district starting from the Brahmaputra, cutting across the horse-shoe of red bank, and finishing with the bed of hill-deposit which we suppose to exist in the jungle to the north. North of this again the soil of the foothills is presumably of red bank character as at Singlijan.

Red Bank Soils.—Of the Bishnath Red Bank, as of the Tezpur Red Bank, we have very few analyses, and it is hoped that we may be able to publish a further note on these soils shortly.

The examples we have show that the Bishnath Red Bank is of very variable composition.

At Borpukhuri the following types occur :—

5, 4, 2, 3, 1.
5, 3, 2, 1, 4.
5, 2, 1, 4, 3.
5, 2, 1, 3, 4.
1, 3, 2, 5, 4.

The clay here averages 27 %, and in one sample is as high as 35 %. These soils are comparable with the red bank soils of the Dooars and are much heavier than those of Tezpur.

Majulighur is on the whole considerably lighter and shows the following types :—

5, 2, 4, 3, 1.
1, 5, 2, 3, 4.
1, 2, 5, 4, 3.
1, 2, 4, 5, 3.
2, 1, 3, 4, 5.
2, 3, 4, 1, 5.
2, 4, 3, 1, 5.

The first two resemble the heavier types from Borpukhuri, but in the remainder the clay averages only about 15 %.

The Majulighur soils, with the exception of the first two, resemble generally those of the Tezpur Bank.

THE DARRANG SOIL SURVEY.

Part V.

BISHNATH.

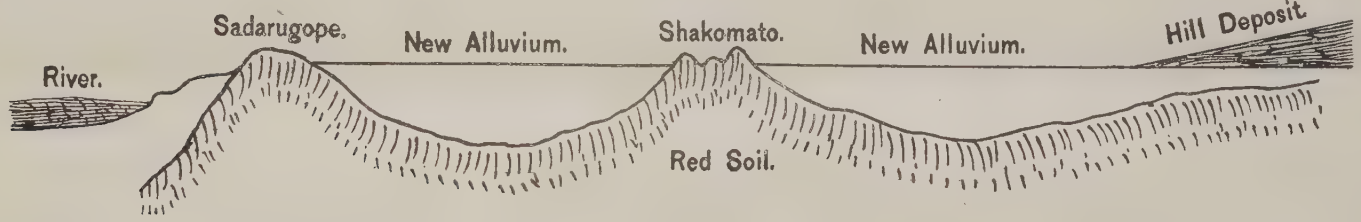

Diagram II.

Showing Section of land from Brahmaputra River North towards Himalayas, in Bishnath District.

Illustrating outcrops of Red Soil from Newer Alluvium.

Table I shows typical analyses of the red bank.

TABLE I.

Typical Analyses of Bishnath Red Bank Soils.

	1	2	3
Physical Type.	5, 4, 2, 3, 1.	1, 5, 2, 3, 4.	2, 3, 1, 5, 4.
MECHANICAL ANALYSES.			
Coarse sand	8	30	26
Fine sand	18	15	18
Silt	16	13	24
Fine silt	21	12	12
Clay	29	23	14
Loss on ignition	6·8	6·0	4·7
CHEMICAL ANALYSES			
Grandeau organic matter (soluble humus)...	2·0	2·1	1·7
Insoluble siliceous matter	76	80	83
*Acidity	1545	1028	1562
Total nitrogen	·100	·108	·067
,, phosphoric acid	·042	·047	·150
Available phosphoric acid	012	·009	·017
,, potash	·013	.018	·010
,, lime	·027	·047	·022
,, magnesia	·060	·048	·050

Nos. 1 and 2 resemble many of the soils of the Dooars Red Bank, No. 3 is a light type resembling the Red Bank soil of Tezpur.

All are good soils.

No. 3, like many others here and in Tezpur, requires regular nitrogenous manuring. The manure may be added in any economical form.

Nos. 1 and 2, although better off in this respect, will undoubtedly respond to additions of nitrogen.

In No. 2 the phosphoric acid is well below the average and needs increasing. On No. 3 potash is likely to prove useful to a soil with so much sand.

In other respects fertility needs maintaining only.

* Lyon & Bizzel modification of Veitch-Albert Method.

On Nos. 1 and 3 occasional light liming will probably do good, but about 10 mds. slaked lime every fourth year is probably quite enough.

No. 2 probably needs no more lime for some time.

In all, but in the heavy No. 1 particularly, steady and lasting improvement will be effected by systematic additions of organic matter.

The New Alluvium.—Apart from the red bank the Bishnath district is occupied by the great sweep of river deposit already referred to.

Here we are fortunate enough to possess 76 analyses, a number sufficient to give us an idea of the kind of variation occurring in soils deposited from more or less the same material under locally differing circumstances.

It may be well to recapitulate that the coarser the material the faster must be the current which can carry it in suspension. Water moving rapidly enough to carry coarse sand will of course carry all the more finely divided material also. If such water is suddenly stopped the coarser material will fall first, the clay only slowly settling from the stagnant water. Sand in settling will however carry down with it finer material that has become entangled with the sand particles, so that even the coarsest soils always contain some fine particles.

The coarsest soils are therefore found where water has been running sufficiently strongly to wash out finer particles after the deposition of the sand. Such soils are found wherever there is an abrupt decrease in slope or on banks of fast-flowing rivers. Patches of heavier soil among stretches of sand will be in hollows where a stagnant pool was left from which fine particles slowly settled out.

On the slowing up of streams already too slow to carry coarse sand, medium soils will be deposited. Real clays are only deposited ready-made from still water, but many clay soils have been formed by weathering of coarser deposits or of virgin rock.

It may be well here also to recapitulate the system of nomenclature suggested by Hope and Carpenter to distinguish between different soils.

To save quoting the full analyses, soils are referred to "types" indicated by numbers according to the order of the proportions in which the various soil constituents occur.

In a mechanical analysis a soil is divided into five constituents according to the coarseness of the particles.

1. Coarse sand.
2. Fine sand.
3. Silt.
4. Fine silt.
5. Clay.

If we have soils of the following mechanical analyses

		A.	B.
1.	Coarse sand ...	5 per cent.	10 per cent.
2.	Fine sand ...	40 „	40 „
3.	Silt ...	15 „	15 „
4.	Fine silt ...	30 „	30 „
5.	Clay ...	10 „	5 „

Then in soil "A" the second coarsest constituent, fine sand, occurs in greatest proportion, so we write "2" first. Next comes fine silt, which is No. 4 constituent, so we write "4" next. Fine silt is followed by silt (No. 3 constituent), and that by clay (No. 5 constituent). The constituent occurring in smallest proportion is No. 1, the coarse sand, so we write that last.

When we say this soil is "of the 2, 4, 3, 5, 1, type," it tells us roughly the composition of the soil, very shortly.

It will be seen that "B" is of the 2, 4, 3, 1, 5, type.

A and B differ only very slightly. If we consider only the three constituents occurring in greatest proportion we can say that both are of the 2, 4, 3, type.

Naming in this way only the three constituents of a soil occurring in greatest quantity we can divide all soils into 60 different types, such as the 2, 4, 3, 1, 2, 5, etc., etc. If all five constituents are given then there are 120 different sub-types, *e.g.*, the 2, 4, 3, 1, 5; 2, 4, 3, 5, 1; 1, 2, 5, 3, 4; 1, 2, 5, 4, 3, etc., etc.

Soils of the New Alluvium of Bishnath.

Outside the red bank the district is occupied by a stretch of alluvial deposit of which sand forms the greater part.

The following soil types occur :—

Bishnath area.—

Dikorai Tezalputi	1, 2, 4, 3, 5.
„ Balijuri	1, 2, 4, 5, 3.
Diplonga ...	3, 2, 5, 1, 4 ; 3, 5, 1, 2, 4.
Ghiladhari ...	1, 2, 4, 3, 5 ; 2, 1, 4, 3, 5. (3 examples).
Mijicajan ...	1, 2, 4, 3, 5 ; (2 examples)
	2, 1, 3, 4, 5 ; (3 examples)
	2, 1, 4, 3, 5 ; 2, 4, 1, 3, 5.
	2, 3, 4, 5, 1 ; (2 examples)
	2, 4, 3, 5, 1.

Behali area.—

Borgang	2, 1, 3, 4, 5 ; (3 examples)
	1, 2, 3, 4, 5 ; (3 examples)
Kettela	1, 2, 3, 4, 5 ; 2, 1, 3, 4, 5. (4 examples)
	2, 1, 4, 5, 3.
Borbheel	2, 1, 3, 4, 5 ; (2 examples)
	2, 1, 4, 3, 5 ; „
	2, 3, 1, 4, 5 ; „
	2, 3, 4, 1, 5 ; (3 examples)
	2, 3, 4, 5, 1 ;
	1, 2, 5, 3, 4 ; 4, 5, 3, 2, 1.
Monabari	2, 1, 3, 4, 5 ; 2, 1, 4, 3, 5 ; (2 examples)
	2, 3, 4, 5, 1 ; 2, 4, 3, 1, 5.
	4, 2, 5, 3, 1.

Boroi area.—

Dufflaghur	1, 2, 3, 4, 5 ; (3 examples)
	2, 3, 4, 1, 5 ; (2 examples)
	3, 2, 4, 1, 5 ; (3 examples)
	3, 4, 2, 1, 5.
Dalhousie	2, 4, 3, 5, 1 ; 3, 2, 4, 1, 5 ; 4, 2, 3, 1, 5.
	4, 3, 5, 2, 1 ;
Gohpur	1, 2, 3, 4, 5 ; 2, 1, 3, 4, 5 ; 1, 2, 4, 3, 5.

Boroi	1, 2, 3, 4, 5 ; (2 examples)
	1, 2, 3, 5, 4 ; (4 examples)
	2, 1, 3, 4, 5 ; 2, 1, 3, 5, 4.
	2, 3, 4, 1, 5.

Among the 76 analyses we have the following soil types, considering only the three chief constituents.

1, 2, 3	14 examples
1, 2, 4	7 examples
2, 1, 3	17 examples
2, 1, 4	9 examples
2, 3, 1	2 examples
2, 4, 1	2 examples

These include all the true sands. It will be seen that all these are closely related.

The 1, 2, 3 type is of course the sandiest type of soil which can exist.

A small increase in fine silt and a small decrease in silt will give a soil of the 1, 2, 4 type. From these two all the others can be derived by an increase in one constituent at the expense of another.

1, 2, 3, → 1, 2, 4.
↓ ↓
2, 1, 3, → 2, 1, 4.
↓ ↓
2, 3, 1, → 2, 4, 1.

The last two contain only a little coarse sand. From a little slower water, still less coarse sand would be deposited, so that its place will be taken by another constituent.

We thus get as close relations of the 2, 3, 1 and 2, 4, 1 types, the 2, 3, 4 and 2, 4, 3 types.

These two last are again related to other types thus :

2, 3, 4, → 2, 4, 3.
↓ ↓
3, 2, 4, 4, 2, 3.
↓ ↓
3, 4, 2, → 4, 3, 2.

These six types have previously been described as "silt-loam" types; and they are, as expected, very common among the alluvial tea soils, being often found in close proximity to their near relations, the sands. They will, of course, be deposited from water not fast enough to carry much coarse sand. As tea soils they are physically excellent. Having little clay, water movements through the soil are not unduly retarded, so that water does not lie; while, having little coarse sand, water is not lost too rapidly, so that they are not so subject to drought as more sandy soils.

Of the "silt-loam" types the following occur in Bishnath :—

2, 3, 4	10 examples.
2, 4, 3	3 examples.
3, 2, 4	4 examples.
3, 4, 2	1 example.
4, 2, 3	1 example.
4, 3, 2	no example.

Only the sandiest examples of "silt-loam" are common in Bishnath.

Thus, of the 60 possible soil types only 11 closely related types are found among the characteristic alluvial soils of Bishnath; and of these eleven types, five types include six-sevenths of all the soils found. Out of 76 soils, 47 belong to the coarsely sandy types 1, 2, 3; 1, 2, 4; 2, 1, 3; 2, 1, 4; and 10 to the sandiest silt-loam type 2, 3, 4.

Outside the above 11 types the following occur:

At Diplonga:—The 3, 2, 5 and 3, 5, 1 types. Diplonga is in the line of prolongation of the red bank, and red bank soil occurs near the surface. These soils are probably mixed with red bank material.

Borbheel.—The 1, 2, 5; 4, 5, 3; types.

Monabarrie.—The 4, 2, 5; type.

Dalhousie.—The 4, 3, 5; type.

These are, in some cases, deposits in hollow places where a stagnant pool was left; but are often noticeably red in colour and possibly represent red bank soil just appearing at the surface.

The average analyses of the five commonly occurring types are given below :—

TABLE II.

	1. 2. 3. type	2. 1. 3. type	1. 2. 4. type	2. 1. 4. type	2. 3. 4. type
MECHANICAL ANALYSES.					
Coarse sand	55	24	43	24	11
Fine sand	26	39	32	41	38
Silt	10	16	6	10	22
Fine silt	4	10	10	13	16
Clay	2	7	5	7	9
Loss on ignition (total organic matter) ...	2·6	3·4	3·4	3·9	3·9
CHEMICAL ANALYSES.					
Grandeau organic matter ...	0·8	1·1	1·4	1·2	0·9
Insoluble silicious matter ...	91	90	90	91	87
Acidity	700	920	1300	1340	1080
Total nitrogen	0 07	0·08	0·10	0 10	0·09
Total phosphoric acid	0·04	0 05	0·05	0 06	0·04
Available phosphoric acid ...	0·011	0·011	0·014	0·018	0·006
„ potash	0·007	0·010	0·013	0·011	0·012
„ lime	0·05	0·05	0·04	0·05	0·07
„ magnesia	0·05	0·04	0·04	0·03	0·05

The distinctly lower Grandeau organic matter and acidity of the soils containing much silt (1,2,3 ; 2,1,3 ; and 2,3,4 types ; silt being No. 3 constituent) may be significant.

High organic matter and acidity are signs of a soil's age.

Carpenter, dealing with the Red Bank Soils of the Dooar (Quarterly Journal 1921, pt. IV), writes, "It would seem that here is considerable resistance to weathering beyond the silt stage." The 1,2,4, and 2,1,4, types are therefore possibly older than the 1,2,3 ; and 2,1,3 ; and 2,3,4. This agrees with the evidence of chemical richness pointing to the fact that the 1,2,4 and 2,1,4 types are older than the other three types ; that these have been longer subjected to weathering and have therefore accumulated greater fertility. In the case of the Bishnath soils, however, the difference is not great.

There is, of course, great variation in richness among soils of the same physical type. A soil found to be poorer in any

respect than the average of its physical type shown above certainly needs addition of that constituent, while even the best of these soils needs all the organic matter which can be applied economically, to increase its water-holding capacity, resistance to drought, and general stability. All these soils, too, are such as will give good results from any form of nitrogenous manure, though organic manures such as fish and animal meals, oilcakes and cattle manure are to be preferred when cost is not unduly great.

Additions of nitrogen should generally be balanced by adding potash and phosphoric acid also.

In the sandy area there are no examples of soils actually alkaline, but there are patches of soil of high lime content and very low acidity which have clearly been left by streams from the hills in flood.

An example is soil A. in Table III. Like soils of similar origin in other districts it is very high in lime and in available phosphoric acid, while the Grandeau organic matter is very low. Tea does not flourish. The nitrogen, as is often the case on such soils, is rather higher than in normal acid soils of the same mechanical composition. Although they are not suited for tea, leguminous jungle flourishes wonderfully on these patches and adds to the store of nitrogen, while there is some evidence that the free-living nitrogen-fixing bacteria are more efficient on such soils than on normally acid ones. On these soils the best method of treatment is to take advantage of its suitability for leguminous crops, and to plant tea only after many such crops have been hoed in. Where tea is already planted the use of sulphate of ammonia as manure is strongly recommended.

It will have been observed that in this and in previous Soil Survey Notes, high lime and either alkalinity or very low acidity are taken as evidence of recent origin of a soil.

On the other hand, red colour and high organic matter are taken as indications of age.

What conclusion, then, can we draw when we find a red soil, fairly rich in organic matter, which is at the same time so rich in lime as to be alkaline ?

The only conclusion that fits in with previous observations is that such a soil is really an old one, but has been rendered alkaline by continuous applications of lime. In this case this conclusion is confirmed by the garden's manuring records.

Soil B in Table III is such a case.

TABLE III.

	A Recent deposit.	B Alkaline old Red Bank soil.
MECHANICAL ANALYSES.		
Coarse sand	19	27
Fine sand	36	19
Silt	14	13
Fine silt	13	17
Clay	13	18
Loss on ignition	4·0	4·7
CHEMICAL ANALYSES.		
Grandeau organic matter	0.5	1·0
Insoluble silicious matter	89	84
Acidity	177	alkaline
Total nitrogen	·113	·101
„ phosphoric acid	·033	·060
Available phosphoric acid	·026	·010
„ potash	·009	·015
„ lime	·113	·128
„ magnesia	·054	·058

Soil B grows tea quite well but not so well as the normally acid red soils. It has undoubtedly been limed too heavily for a tea soil, but it is interesting to note that mere alkalinity does not unfit a soil for tea growing, if the organic matter content is normal. In this case the Grandeau organic matter is almost at the low limit for a fertile tea soil, and is distinctly lower than the average for a good red bank soil (see Table I). This is possibly due to rapid decomposition of organic matter on account of the presence of the lime, but such an inference needs confirmation.

SOME OBSERVATIONS ON STEM AND ROOT DISEASES.

Stem Diseases.

During the past few months there has been a considerable increase in the number of specimens of stem diseases received at Tocklai. The writer paid a short visit to Cachar and the Dooars recently and studied some of the diseases concerned on the spot.

Corticium spp.

The commonest form of stem disease was characterised by wounds extending along one side of the stem. These wounds had sometimes healed leaving a long scar, but in many cases the branches had commenced to decay and large cankers had formed.

It was found that these cankers were not formed by the same fungus in each case, but that a number of fungi were responsible for similar diseases. The commonest of these appeared to be species of *Corticium*. This type of fungus produces very fine threads, which run over the bark and often extend to the leaves. They are almost invisible in one species, while in another they produce visible cords somewhat resembling Thread blight, but quite distinct in character. In most cases the specimens received at Tocklai bore no trace of these fungi, only the wounds and scars were apparent. These were often infected by other fungi and frequently the bushes were also attacked by *Thyridariat arda*. As the fungi concerned were of the kind unlikely to produce cankers further investigation was carried out to ascertain the original cause of the cankers. Later, the various stages in the formation of the cankers were observed, and the fungi causing them were isolated.

In the Dooars and in Cachar a species of *Corticium* was observed which was obviously attacking the bark of the tea, in most cases killing it in long strips, sometimes on the upper surface but more often on the under side. The young red wood is often completely ringed and dead. The external mycelium of the fungus

is white and occasionally collects together in threads of sufficient thickness to be visible to the naked eye. The fructifications of the fungus are to be found on small twigs which have been dead some time and are about to fall off. The fructifications are pinkish white patches about $\frac{1}{8}''$ to $\frac{1}{4}''$ in diameter. The fungus does not appear to attack the leaves at all, but many of the leaves die because of the reduction in food supply due to the damage to the stems.

Another species of *Corticium* was also found often on the same gardens. This was able to attack the leaves in a manner resembling the Black Rot found in Assam, but the fructifications did not appear to be found on the leaves, but on the young stems before the death of the latter. In this case the fungal mycelium was invisible to the naked eye. This fungus resembles the one described by Petch as being common in Ceylon. This fungus appears in patches of tea. The tea may appear quite healthy one day and the next day the leaves on a patch of 20 or 30 bushes suddenly become mottled with red patches between the veins. The progress of this disease is extraordinarily rapid and in a few days the bushes seem to be almost dead, all the leaves and young shoots having died back. The bushes recover to some extent, but are soon re-attacked, and if untreated will die right out.

If the bushes survive the attacks of these fungi for any length of time, the bark begins to grow over the portions which have been killed by the *Corticium* and strips and ridges of new cortex are produced. In some cases the wound is completely covered, but as a rule other fungi attack the dead bark and spread thence to the wood, causing the damaged branches to decay and ultimately die right back. In Cachar one of the commonest is *Auricularia Auricula judiae*. The fungus produces brown gelatinous fruits like ears. It kills the branches and in time extends to the roots. It is a wound parasite and does not appear to attack the tea except through wounds caused by other agencies. Another common fungus which follows the wounds caused by *Corticium* is *Thyridaria*. This fungus attacks the whole bush, causing it to become moribund and eventually killing it altogether. The characteristics of this disease have been described before on a number of occasions.

Pestalozzia sp.

On two gardens in the Dooars a stem disease was found on areas which had been badly attacked by Mosquito blight in former years. The stems in this case bore curious swellings, not continuous, like those produced by the *Corticium* species, but at irregular intervals. In many cases the early stages are characterised by a row of small cracks through which new bark appears. These were usually near the axils of leaves on red wood. The fungus present in these cankers was isolated and grown in pure culture. It produced spores in time and was found to be similar to, if not identical with, that producing Grey blight—*Pestalozzia theae*. The stems of undiseased tea bushes were inoculated with the fungus in various ways. It was found that the fungus was only able to infect at wounds. The characteristic swellings developed where the fungus was inoculated into pin pricks. Stems similarly pricked but not inoculated did not produce the swellings. To make assurance doubly sure the fungus was re-isolated from the artificially produced swellings. It would seem that the fungus infected the plant at the punctures made by the female mosquito when depositing her eggs. The fungus, however, causes the tea to die back and seriously reduces crop.

Nectria cinnabarina.

Another stem disease is doing considerable damage. This is caused by *Nectria cinnabarina*. In this case cankers are rarely produced, but sooner or later the tiny fructifications appear and are easily recognisable. The stems die back slowly and the bush becomes moribund.

Velvet Blight.

From time to time a curious disease of stems known as Blue Velvet Blight appears in Darjeeling. This fungus forms a bluish coloured velvety coating on the stems and the stems frequently die back. Recently a similar fungus has been found in a number of places. It differs in colour however. It is brown, almost the same colour as brown root rot. This fungus looks very alarming but

apparently does no damage. A seedling covered with the fungus was received by post in January last. As it was alive on receipt it was planted in a pot. It is still alive and very vigorous, inspite of its thick overcoat of fungus. However, it is possible that in moister climates the coating of fungus would harbour other disease-producing organisms. It is therefore desirable to strip off the fungus wherever it is found. The fungi in both cases are species of *Septobasidium.*

General treatment of Stem Diseases.

In all the above-mentioned stem diseases, with the exception of the last, it is necessary to proceed as follows :—

1. Cut out all the diseased wood well below the obviously diseased portions. This should be done as soon as possible.

2. The prunings should in all cases be burned at once.

3. Immediately after 1 and 2 spray thoroughly all diseased patches and the bushes in their vicinity with Lime sulphur solution (See "Notes on the Spraying of Tea" referred to on the cover of this Journal) stock solution diluted 8 times with water.

In the following cold weather.

4. Go over the sections again and wherever the disease is still present repeat the treatment.

5. Spray all sections on which the disease has been found with Lime sulphur solution. Stock solution diluted 5 times.

6. Paint all the cuts on heavy pruned or cut back tea with the following fungicidal paste.

Dissolve 4 lbs. of Copper sulphate by suspending it in a bag in 1 gallon of hot rice water. When cold add sufficient slaked lime to form a paste. This paste is more satisfactory than that suggested in previous Quarterly Journals.

It is most important that treatment should be carried out as soon as possible, as most of the diseases concerned spread rapidly, and if a large area is allowed to become infected the loss in crop and the cost of treatment are likely to be very considerable.

Root Diseases.

In addition to the abnormal increase in stem diseases there have been a number of exceptional cases of root disease. Early in the season the writer investigated a root disease closely resembling that caused by *Thyridaria tarda*. The latter disease is invariably found on sandy soils. The case in question was on a stiff, very hard soil. The fungus was a *Diplodia* like *Thyridaria tarda*, but different in some respects. The small black dots produced on the dead roots were in this case often accompanied by tufts of white mycelium. In this respect it resembled the description given by Petch of *Diplodia* root disease found in Ceylon.

Poria spp.

About the same time a number of specimens were received bearing fructifications of species of *Poria*. Petch says that the commonest root disease in Ceylon is caused by *Poria hypolateritia*. It is curious that in the tea district of North-East India so few specimens of *Poria* species have been found on tea. This year, however, at least two distinct species have been found on tea. In all cases the plants were growing in stiff soils.

Poria species produce thick strands of fungus, resembling roots, which spread starwise both outside and under the bark of the roots. The strands of mycelium often spread upwards to the branches. After the death of the bush, sometimes before, the fructification forms. This is a plate adhering to a branch. The plate is eventually covered with minute pores. The colour of the plate and of the strands of fungus varies with the species.

The commoner species has a yellowish brown fructification and white or cream mycelium. This later becomes black and in this stage may be mistaken for *Sphaerostilbe repens*. Another species has a pinkish coloured fructification and mycelium of a similar colour.

Polyporus sp.

In addition to the *Porias*, on the same class of soil a species of *Polyporus* has also appeared on tea. This has white bracket-like fruits produced in clusters just above the collar. The mycelium is white and somewhat fluffy. It spreads over the roots in thick strands.

Fomes lucidus.

Fomes lucidus was also found this year more frequently than usual. This fungus is easily recognised by the hard bracket fructifications it produces on the dead stumps. The upper surface of the bracket is coloured red brown and often presents a varnished appearance.

On one garden in the Dooars, on a small section of stiff black soil, all the above-mentioned diseases were represented and another one in addition. In this case the Sau trees, particularly the *Albizzia moluccanas*, were dying back, and an examination of the roots showed that the dying back was caused by root diseases and the root diseases had spread to the tea from them.

Soil treatment very important.

All the above-mentioned diseases were found on stiff soils, and in devising treatment special attention has to be paid to the peculiar soil conditions. In the case of the diseases caused by species of *Poria, Polyporus and Fomes lucidus* mere removal of the dead roots is not sufficient as the fungus actually grows through the soil. By digging trenches round the diseased bushes and removing the latter carefully the disease may be checked, but it is unlikely that it will be eradicated until the physical condition of the soil is improved. In some cases, owing to the nature of the soil and the climatic conditions, it is impossible to bring about satisfactory aeration by drainage. Hoeing when the soil is soaking wet makes matters worse, while hoeing when it is dry is almost impossible owing to its excessive hardness. It is necessary therefore to cultivate this soil just at the right time—when it is not too wet nor yet too dry. Such soils should not be hoed when too wet to crumble. Thorough cultivation at this time will go a long way towards checking the disease. The corpses and diseased plants must of course be removed and burned as soon as possible and a heavy dressing of lime applied to the soil wherever the diseases appear. In addition, if the chemical condition of the soil requires it, the whole of the stiff area should be heavily limed at the time the through cultivation is given.

A. C. T.